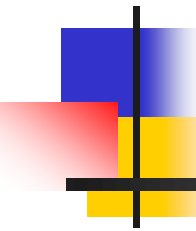
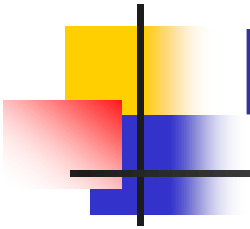


RCS 205
Operating Systems

Lecture 1:

Introduction

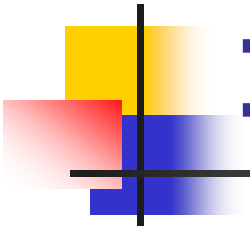


Lecture 1:

- Scope:
  - Introduction.
  - Functions of O.S.
  - Operating System concepts.
- Lecture objectives:
  - Define operating system.
  - Understand the functions of an operating system.
  - Examine different concepts that come with operating system.

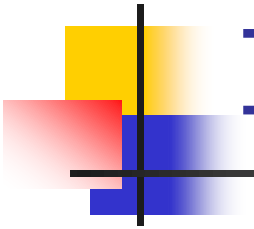
Introduction:

- A computer without software is useless. Software makes a computer become live.
- With software a computer can store, process and retrieve information.
- Software make a computer system to become alive
- Computer Software can be divided into two forms:
  - ***System programs***
  - ***Application programs.***



Introduction:

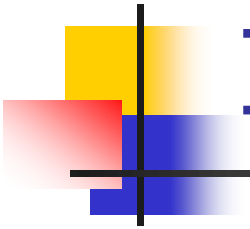
- System programs manage the operations of the computer itself
- Application programs perform the work that the user wants.
- The most fundamental system program is the **Operating System**
- An **Operating System**:
  - controls all computer resources
  - provides the base upon which application programs run.



Introduction:

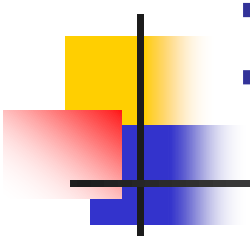
Definition:

"An operating system is a system program that acts as an intermediary between a user of a computer and the computer hardware."



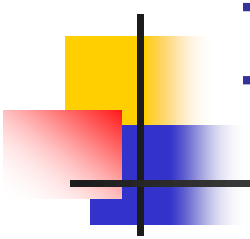
Introduction:

- Before the introduction of O/S, computers ran one program at a time.
- The programmer would write a program and submit it to the operator who would run it.
  - Programs were written on punch card
- The programmer would then come for the output later on.
  - The results were in the form of either the real output or dump of errors.



Introduction:

- As technology advanced, it became possible to put all the jobs or programs in a single tape.
- The tape is then loaded and manipulated by a another program (called *monitor*), which monitors behavior of the jobs
- Apparently, this process was cumbersome and complex

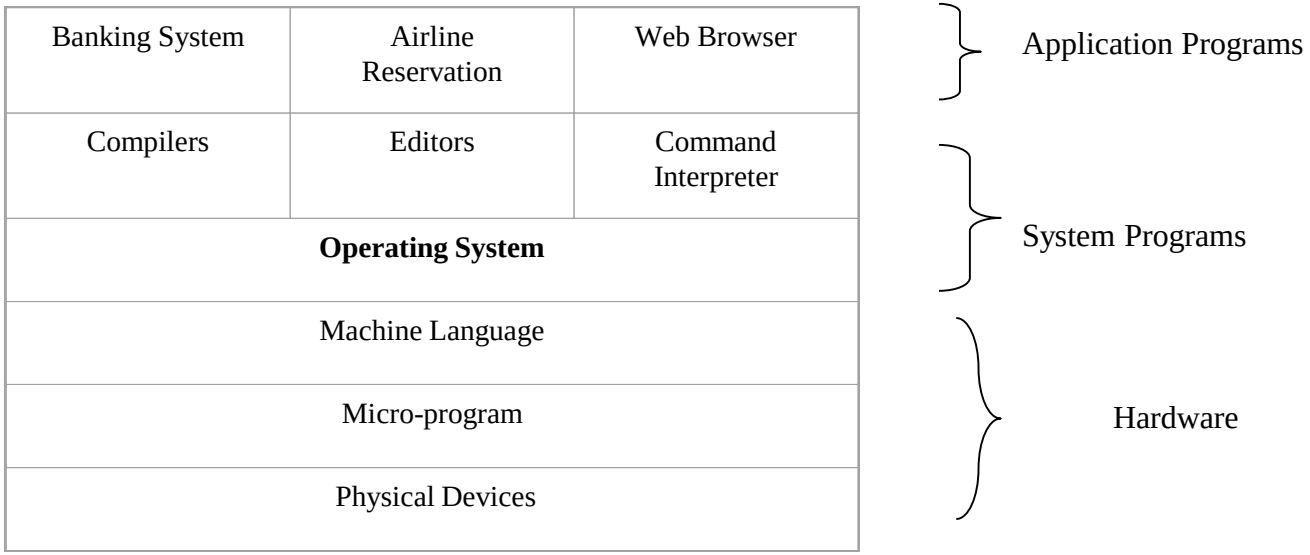


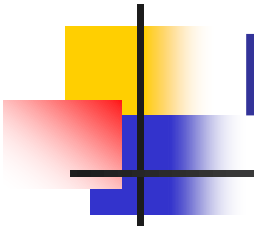
Introduction…

- A way had to be found to shield programmers from complexity of the hardware and allow for sharing of the vast computer resources.
- This solution is to put of a layer of software on top of hardware to manage all resources and provide a *virtual machine* that is easier to use and program.
  - A *virtual machine* is software that creates an environment between the computer platform and the end-user.
- An Operating System is a *resource allocator* (CPU time, memory, file storage, I/O devices etc.)

Introduction…

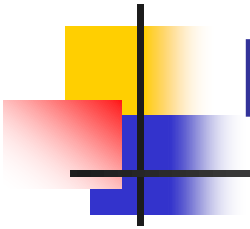
- The concept of an operating system can be illustrated using the following diagram:





Functions of Operating System:

- Operating Systems perform two unrelated functions:
  - Provision of a virtual machine
  - Resource management



Functions of Operating System…

- **Provision of a virtual machine**
  - A Programmer does not want to be involved in programming devices like memory, floppy and hard disk
  - What a programmer needs is a high-level abstraction
  - For example, in case of disks, the abstraction is that the disk contains a collection of files that may be opened, read, written and closed
  - The Operating system provides this abstraction

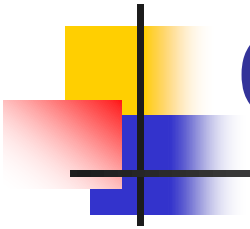
Functions of Operating System

Resource Manager

- An Operating System provides for orderly and controlled allocation of CPU, memory and I/O devices among processes competing for them.
  - For example, if two processes are competing for the same printer and the sharing is not controlled, printing will be interleaved.
- Consequently, the O/S keeps track of who is using which resource, grant resource requests, account for usage and mediate conflicting requests from different processes

Operating system concepts

- The interface between the O/S and user programs is defined by a set of 'extended' instructions that the O/S provides
- These instructions are referred to as *system calls*.
- Other concepts that go hand in hand with operating systems include:
  - Processes.
  - Files.
  - Batch systems.
  - Multiprogramming.
  - Time-sharing systems.
  - Timer interrupts.
  - Virtual memory.
  - Parallel systems.



Operating system concepts…

a. Processes

- A process is a program in execution
- Each process has its address space containing the executing program, its data and stack
- Also associated with each process is a set of registers (program counter, stack pointer …)
- In a time sharing system, when a process is suspended from the CPU, its context must be saved so that its restarted at exactly the same state.

Operating system concepts …

Processes

- A suspended program consists of its address space (***core image)*** and its process table entry.
- A process can create other processes known as *child processes* and these processes can in turn create other child processes.
- Processes at times need to communicate with one another when cooperating to finish some task. This is referred to as Inter-process Communication (IPC)

Operating system concepts …

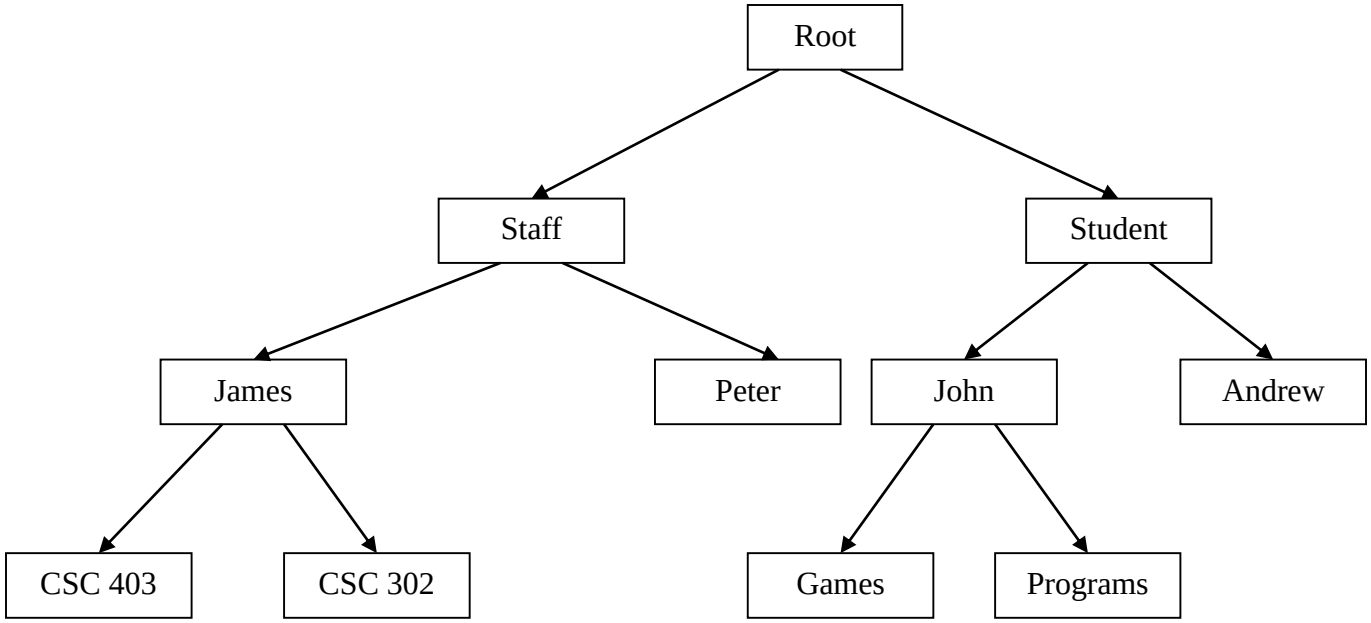
b. Files

- A file (program or data) is a collection of related information defined by its creator .
- There are system calls for creation, copying, deletion, movement, reading and writing of files.
- For easy access, files are organized into logical clusters or directories
- For example, you have directories for word processing documents, spreadsheets, databases, programs etc

Operating system concepts …

Files

- Directories give rise to hierarchical file system as shown below:



Operating system concepts …

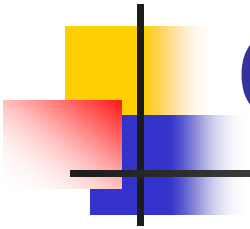
Files

- An absolute name of a file is specified by giving its *path name* from the *root directory*
- Absolute path names consist of the list of directories traversed from the root directory to get to the file with slashes separating the components.
  - For example, the path for the file CSC302 can be specified by*: /Staff/James/CSC302.*
- The *relative path name* is specified by giving the path name of a file from the current directory,
  - for example, *James/CSC302*, with current directory */Staff*

Operating system concepts …

C. Batch Systems

- Early operating systems were *batch systems*.
  - Common input devices were card readers and tape drives.
  - Common output devices were line printers, tape drives and card punches
- Users would submit their jobs to the operator.
- Major task of O/S was to transfer control from one job to the next
- Jobs with similar needs were batched together and run as a group to speed processing
  - The *turnaround time* in these systems was high



Operating system concepts…

Batch Systems

- The CPU, is often idle because of the disparity in speed between it and the I/O devices.
- Spooling was introduced to reduce the *turnaround time* and CPU *idle time* in these systems, the spool.
- Spooling, in essence uses the disk as a buffer, for reading as far ahead as possible on input device and for storing output files until the output device is able to accept them.

Operating system concepts …

d. Multiprogramming

- Spooling results in several ready jobs to be put in memory, selecting the job is referred to as *job scheduling.*
- The O/S manages the process of job scheduling i.e. does some memory management
- The most important aspect of job scheduling is the ability to multi-program.

Operating system concepts …

Multiprogramming

- The O/S picks and executes any of the jobs in memory
- Eventually, a job will wait for some operation such as I/O
- In multiprogramming, when this happens the O/S, simply switches to and executes another job.
- Making this decision is known as *CPU scheduling.*

Operating system concepts …

e. Time Sharing Systems

- *Time-sharing*, or *multitasking* is a logical extension of multiprogramming.
- In time-sharing, multiple jobs, are executed by the CPU switching between so frequently that the users may not realize
- Time-sharing systems were developed to provide interactive use of the computer system

Operating system concepts …

- It allows many users to share the computer simultaneously.
- As the system switches rapidly from one user to the other, the user is given the impression that they have their own computer

Operating system concepts …

f. Timer Interrupts

- Programs were given a specified amount of time for their execution .
- The monitor (O/S) had the ability to interrupt the program in case its execution time expired.

Operating system concepts …

g. Virtual Memory

- Gives a program the illusion that it has as much memory as it needs
- A program is divided into pages so that a page is brought in memory at any given time
- There was shifting of pages depending on the processing demands

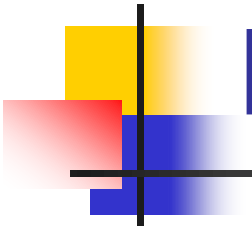
Operating system concepts …

h. Parallel System

- Most computers are single process systems
- However, the trend is towards having multiprocessing systems
- Such systems have more than one processor in close communication, sharing the computer bus, clock, memory and peripheral devices
- Motivation for having such systems is to improve the *throughput* and *reliability* of the system.

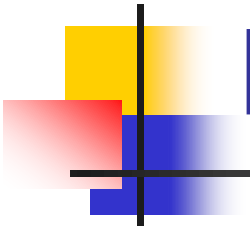
Types of Operating systems:

- Different schemes are used to categorize operating systems.
- The most common types are:
  - Single tasking operating systems.
  - Multitasking operating systems.
  - Single user operating systems.
  - Multi user operating systems.
  - Virtual memory operating systems.
  - Network operating systems.
  - Distributed operating systems.
  - Parallel operating systems.



Lecture review:

- What is an operating system?
- What are the main functions of an operating system?
- Briefly outline any three operating system concepts.
- What is the difference between multiprogramming and multitasking?



Next lecture:

- Scope:
  - Types of computer systems.
  - Historic overview.

- Homework 1
  - Describe the general features of the different types of operating systems. In each case, give an appropriate example.